

## Evaluating Emergency Department Resource Capacity Using Simulation

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### Abstract

Emergency departments open 24 hours every day and may receive patients at any time most unexpectedly. Adequate resource planning to meet the various demands in emergency departments is arguably amongst the most critical challenges faced by hospital administrators due to the complexity of the system and diverse patient flows. In this paper, we present a computer simulation model to evaluate resource utilization among personnel and physical resources in a typical emergency department (ED) of a government hospital in Malaysia. The model allows administrators to see patient movement flows as well as how these flows are affected by resource capacity level in the ED. The use of this simulation model helps to evaluate ED operations, provides useful insight for possible areas of improvement, and directs the allocation of specific resources for maximal impact. Three scenarios were tested to find out the impact of patient surge on ED performance measures. Results from the scenarios show that a 30% increase of attendances according to triage zones affects most of the performance measures. In addition, medical assistants are the critical resources with average utilization greater than 70%.

**Keywords:** computer simulation, discrete-event simulation, emergency department

### 1. Introduction

In Malaysia, emergency department (ED) in government hospitals is the front door for patients seeking for immediate treatment. The emergency patients often expect to receive treatment with minimum delay and in a timely manner. Lack of resource capacity, such as beds, doctors and nurses will hamper the care process and reduce health care quality, as well as increasing the potential of medical errors and long waiting times. This scenario is inherently difficult because in hospital, capacity decision is a major determinant for providing services over a specified time interval. Due to this, a sound capacity analysis is required to help ED administrations evaluate the resource utilization and system performance efficiency periodically.

ED entails three main components, which are people, processes and equipments. Therefore, modelling an ED system requires an approach that can portray the integrated relation between those three components. Due to this fact, the use of analytical models that requires many assumptions and simplifications seems not practical for ED modelling. A significant amount of reported studies in health care has been conducted in EDs (Jun, Jacobson, & Swisher, 1999). Among these studies, simulation has outnumbered other Operations Research approaches to model EDs (Ruohonen, Neittaanmaki, & Teittinen, 2006). Simulation is chosen for at least three reasons: Firstly, healthcare systems require stochastic approach as there are many uncertainties and variability that are involved in the systems. Secondly, the complex nature of healthcare systems requires a modelling approach that can deal with complexity. Finally, human involvement in healthcare systems needs proper approach for interactions and communications between modeller and user (Brailsford, 2007).